

Handling Guideline for the EEVC WG 17 Legform Impactor

Version 1.0

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1. Objective

To ensure the highest possible repeatability and reproducibility of the test parameters in tests with the EEVC WG 17 legform impactor, concomitant with a least possible uncertainty of results, special care while dealing with the legform impactor has to be taken.

Attention has to be drawn to the fact that during certification tests many potential defects and inaccuracies are not necessarily detected.

The following list shall help to achieve this quality. The list is regarded as an addition to the legform's user manual, which has to be followed closely, and is not exhaustive. It shall rather call attention to possible mistakes and make the users sensitive for inaccuracies.

- *Short justifications of the points listed are made by comments in italics.*

2. Certification of the legform impactor

- According to the calibration procedures and intervals documented in the test regulations
- Usability of the impactor only when every specification is complied with
- Impactor shall be certified as a complete unit, i.e. with the same batch of ligaments and the same batch of foam piece as in the test that follows
 - *Users may purchase certified foam pieces and certified ligaments and use the impactor continuously without certification of the impactor itself.*
- Certification of the potentiometers within the effective range
- Certification of the potentiometers in steps of max. 2 degrees
 - *Following these two points will increase the measurement accuracy. Potentiometer certification is often made in steps of 10 degrees over the whole range (approx. 360 degrees) whereas the sensitivity is not always exactly linear.*
- Certification of the impactor within a relative humidity range between 25% and 45%
 - *Foam is sensitive to humidity*

3. Additional verifications on the occasion of certification

- Check of total mass
 - *Mass may vary due to support fixtures, different cabling etc.*
- Verify the center of gravity of femur and tibia

- *The centers of gravity are adjustable, i.e. they may have been changed accidentally*
- Verify the correct mounting position of the tibia insert: The accelerometer has to be positioned on the rear side of the legform
 - *The tibia and its insert may be twisted accidentally.*
- Verify the correct mounting of the potentiometer
 - *If potentiometer mounting is wrong or loose, measurement cannot be correct.*
- Verify the electric position of the potentiometer: There should be no point of discontinuity and no zero point within the effective range
 - *Otherwise there may be a jump in the signal or a change in sensitivity within the measurement.*
- Verify the correct position of the accelerometer: Entran sensors can be fastened to the wrong screw drilling
 - *If an accelerometer is mounted incorrectly, its sensitive axis will not be at the required position of the legform*
- Check the operability and correct, centre position of damper adjustment.
 - *Otherwise the damper may reduce the shearing possibility*

4. Additional verifications before each test

- *It is essential to perform these verifications before every single test! Each of the following points may occur in any test irrespective of the condition of the legform before test!*
- Check and correction of possible rotation of the femur insert
 - *Insert rotation causes changes in legform performance.*
- Check and correction of possible rotation of the tibia insert
 - *Insert rotation causes changes in legform performance.*
- Check and correction of possible deformation of the shear spring, to be seen at an excentric position of the femur ligament socket
 - *Shear spring deformation causes changes in legform performance.*
- Dismounting of the potentiometer rod and check of possible deformation
 - *Rod deformation causes potentiometer offset and imprecise bending measurement*
- Check the potentiometer rod ball joint of defects
 - *Defect of ball joint causes imprecise bending measurement*
- Check the potentiometer guide tube of deformation and correct position

- *Defect of guide tube causes imprecise bending measurement*
- Verify tight mounting of the potentiometers
 - *Loose potentiometer causes wrong measurement*
- Verify tight mounting of the grub screws at the tibia centre weight; if loose: check and correction of the center of gravity
 - *These screws hold the tibia weight in position. If they are loose, the center of gravity may have changed.*
- Verify tight mounting of all mounting screws
 - *Play in screws may cause improper legform performance and imprecise measurements*
- Check wiring for damages
 - *Crushed cables may seem to function properly in static check but fail during testing. Visual and electrical inspections are necessary.*

5. Test preparation

- Mounting of the ligaments: screw down screws lightly first, then set up impactor, finally fix screws tightly
 - *Improves position of the ligaments and performance*
- Check foam piece of damages and deformations
 - *Inhomogeneous foam causes variations of legform performance and measurements*
- Storage of foam piece under the same climatic conditions as in the test for at least 2 hours prior to the test
 - *To allow the foam to acclimatise*
- Never put / store anything on foam piece
 - *Weight on foam pieces causes at least small deformation*
- During the mounting of the foam: position the impactor as short as possible on the foam; afterwards set up the impactor immediately
 - *To reduce foam compression*

6. Test execution

- Ensure avoidance of cable damages during the impact (e.g. by sensor cable suspension)
 - *To avoid loss of measurements*
- Ensure the exact position of the impactor in the guiding system
 - *To improve flight trajectory*
- Ensure the accuracy of the vertical, lateral and longitudinal impact orientation of the impactor - avoidance of rotation of the impactor around the vertical (yaw)-axis, lateral (pitch)-axis and the longitudinal (roll)-axis
 - *Deviation of the orientation causes variation in measurements*
- Ensure the accuracy of the impact height and the lateral impact position of the impactor
 - *Deviation of impact position causes variation in measurements*
- Measurement of the impact velocity in each test
 - *To ensure correct impact speed, which has great influence on results*
- Conducting test within a relative humidity range between 20% and 50 %
 - *Foam is sensitive to humidity*

7. Storage and transport of the foam pieces

- Climatized storage location (within a temperature range between 16 °C and 24 °C, and a relative humidity range between 10% and 70%)
 - *Foam is sensitive to humidity and temperature*
- Climatized storage of the foam pieces before and after the certification until the test
 - *Foam is sensitive to humidity and temperature*
- Horizontal storage and transport, a maximum of 10 foam pieces of equal size on top of each other, no further loads
 - *Foam is soft and sensitive to loads and compression; the number 10 is to be regarded as a rough estimate based on experience*
- No bending and rolling of foam pieces, avoidance of cracks
 - *Foam is likely to crack*
- Maximum storage duration: one year; otherwise further calibration necessary
 - *Foam may alter its characteristics; regulations state that the impactor (including foam!) has to be certified at least every 12 months.*